MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

RAILROAD OPERATIONS

COMMUTER RAIL DESIGN STANDARDS MANUAL

VOLUME I
SECTION III

BRIDGES

March, 2009

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1. Introduction/Purpose

The Massachusetts Bay Transportation Authority (MBTA) owns and maintains bridges that carry railroads and roadways throughout the commuter rail system. The Authority is responsible for ensuring each railroad bridge can safely carry the revenue (passenger) and freight loading that may be operated over the structures, and ensuring that each roadway bridge can safely carry commercial and civilian traffic over the structures. The purpose of this Section is to clearly define the inspection and rating guidelines established by the Authority to ensure compliance with the Federal Railway Administration's (FRA's) "Statement of Agency Policy on the Safety of Railroad Bridges".

The MBTA defines a bridge as any structure with total bridge length (sum of all spans) greater than 20 feet. Culverts are those structures that do not meet the classification requirements of a bridge.

The American Railway Engineering and Maintenance-of-Way Association (AREMA) Bridge Inspection Handbook outlines the criteria for inspection of railroad bridges, and shall be used in conjunction with the United States Department of Transportation Federal Highway Administration (FHWA) Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges, FHWA National Bridge Inspections Standards Regulation (NBIS), and this Section.

The AREMA Manual for Railway Engineering, Volume 2 Structures, Chapter 15 Part 7; Existing Bridges gives the general requirements for inspection and rating of existing steel bridges. The Massachusetts Highway Department (MHD) Bridge Manual, Chapter 7; Bridge Load Rating Guidelines is intended to establish a uniform policy for determining live load capacity of highway bridges in the Commonwealth. Engineers performing inspections and load ratings of MBTA bridges shall use these two references and sound engineering judgment when interpreting the requirements of these codes/guidelines.

A flow chart for inspection and load rating of railroad bridges, which depicts the process graphically, is shown in Figure A1 in Appendix A.

2. Bridge Inspection

2.1. General

All bridges within the MBTA Inventory shall be inspected to evaluate the condition of the structure due to the effects of corrosion, collision, or alterations due to improvement programs that are not reflected on previous inspection reports. All changes need to be thoroughly documented and reported in the inspections so that their effect can be analyzed in subsequent load ratings.

According to the FRA "Regular comprehensive inspections are vital to maintaining valid bridge ratings and to performing timely bridge rating and repair"[1]. Accordingly, standard practice has been to inspect bridges carrying railroad traffic at a frequency not less than once per year.[2]

Many steel commuter rail bridges are fracture critical. Fracture critical bridges are bridges that contain fracture critical members (FCMs), which are tension or bending members whose failure would be expected to result in collapse of all or a portion of the bridge. Fracture critical bridges must be identified as such and particular care must be taken in their inspection and evaluation.

2.2. Existing Plans and Other Documentation

Plans must be verified during inspection for any changes that may have occurred during construction or may have been made during the life of the bridge.

2.3. Inspection Personnel

There are three categories of personnel associated with bridge inspection:

1. Program Manager: in responsible charge of all inspection teams and procedures
2. Team Leader: an Inspector, who is in charge of planning, performing, and reporting the inspection
3. Inspectors: assist the Team Leader in the inspection

According to the FRA, "The inspector is a technician who should be able to reach all parts of the bridge to be inspected, detect indications of deterioration or other problems on the bridge, and accurately record and report them"[3] Specific qualifications for each of the three categories of inspection personnel follow:

[1] Federal Register / Vol. 72, No. 175 / Tuesday, September 11, 2007 / Notices, p 51900
[2] ibid
[3] ibid

2.3.1. Program Manager

The Program Manager shall possess **all** of the following minimum qualifications:

1. Be registered as a Professional Structural Engineer in the Commonwealth of Massachusetts.
2. Have a minimum of ten years experience in the inspection and rating of railroad or highway bridges, depending on the function of the bridge.
3. Have completed a formal bridge inspection training course, covering all facets of bridge inspection.

2.3.2. Team Leader

The Team Leader shall possess **one** of following minimum qualifications:

1. Be registered as a Professional Structural Engineer in the Commonwealth of Massachusetts (Required for Special Inspections and Emergency Inspections).
2. Have a minimum of five years experience in bridge/structure inspection and completed a formal bridge inspection training course.

The Team Leader for the inspection of a fracture critical bridge must have completed a formal training course to recognize fracture critical members and fatigue sensitive details. FHWA Report No. FHWA-IP-86-26 *Inspection of Fracture Critical Bridge Members*, although more geared to highway bridges, this is a valuable resource that provides guidelines for identification, inspection and evaluation of fracture critical members and should be utilized in any training program for bridge inspectors.

2.3.3. Inspector

Inspectors shall possess **one** of following minimum qualifications:

1. A minimum of two years experience in the design and/or construction of bridges or similar structures and have completed a formal inspection training course
2. A bachelor or associate degree in civil engineering/construction, or
3. Meet the qualifications of a Team Leader.

2.4. Inspection Safety Requirements

2.4.1. General

All bridge inspection efforts shall be coordinated with the MBTA, the owner of the structures and right-of-way, and the Massachusetts Bay Commuter Railroad Company (MBCR), the current operator of the commuter rail system, to ensure the safety of personnel working on or around active railroad tracks, and to ensure the safe and timely movement of trains.

2.4.2. MBTA Right-of-Way Training
Prior to any inspection crew entering MBTA right-of-way, or otherwise accessing MBTA bridges or other structures, all individuals must have completed MBTA Right-of-Way Safety Training, and shall carry on their person identification indicating that they are in compliance with the requirements. Additionally, all work performed within the MBTA Right-of-Way, or in the vicinity of any MBTA bridge shall be performed in accordance with the requirements of the MBTA Right-of-Way Safety Rulebook.

2.4.3. MBCR Roadway Worker Protection
Prior to any inspection crew accessing MBTA bridges or other structures, all individuals must have completed MBCR Roadway Worker Protection Training, and shall carry on their person identification indicating that they are in compliance with the requirements. Additionally, all work performed on MBTA property, or in the vicinity of any MBTA bridge shall be performed in accordance with the requirements of the MBCR Roadway Worker Protection Program.

2.4.4. Work within Electrified Corridor
Any work performed for the inspection of bridges or structures within the vicinity of electrified corridor(s) may require electrified catenary to be de-energized. The requirements for de-energizing sections of corridor shall be coordinated with Amtrak. Amtrak safety training will be required when working on electrified corridors operated by Amtrak.

2.4.5. Flagman Protection
Flagman protection shall be used when required by the MBTA, MBCR, Amtrak, and/or freight railroad. No inspection team shall access MBTA property without flagman protection, or written notification from the MBTA indicating that flagman protection is not required.

2.4.6. Detail Police Protection
Detail police protection is provided by MBTA police for any work on MBTA property, including inspection of MBTA owned bridges over local roads.
MBTA Transit Police: (617)222-1212

2.5. Inspection Categories for Railroad Bridges

2.5.1. General
AREMA Chapter 15, Section 7.4 categorizes inspections as Periodic, Special and Emergency as summarized in the following paragraphs.

2.5.2. Periodic Inspection

Periodic Inspections are regular scheduled inspections that shall be performed annually, excluding years when Special Inspections are performed, and shall be performed in accordance with the requirements of AREMA Chapter 15, Section 7.4.3. Periodic Inspections include observations of all components of the bridge. The primary objective of the Periodic Inspection is to identify changes in the condition of the bridge compared with previous inspections.

2.5.3. Special Inspections

Special Inspections are hands-on inspections that shall be performed in accordance with the requirements of AREMA Chapter 15, Section 7.4.4. Special Inspections are carried out to obtain detailed information that includes photographs, verification of bridge dimensions and member sizes, and accurate and member-specific data of any deterioration that may be discovered, including evidence of fatigue related defects. Additional tasks performed during Special Inspections may include, but are not limited to the following:

- Underwater inspection of substructures, including inspection for effects of scour[4]
- Extraction of concrete cores for laboratory testing and evaluation of strength, chloride content, alkali-silica reaction, etc.
- Removal of steel coupons for laboratory testing to determine steel properties.
- Removal of samples from wood elements possibly including piles, for laboratory testing to determine wood properties and ascertain cause of deterioration (fungus, insect, chemical)

The frequency of Special Inspections for MBTA Commuter Rail Bridges shall be five years, or less, and will be determined based on the following:

- The age of the bridge
- The general condition based on previous inspections
- The load rating of the bridge

2.5.4. Fracture Critical Inspections

The MBTA will specify the frequency that fracture critical components of bridges are inspected based on the age of the bridge, findings of past inspections, fatigue rating of fracture critical components, and annual tonnage

[4] Scour, or the erosion of stream bed in the area of piers and abutments, is related to stream flow velocity, resulting turbulence around piers and abutments and the composition streambed material.

carried over the bridge. At a minimum, Fracture Critical Inspections shall be conducted at a two-year interval, following the criteria outlined below:

Condition Rating	Determining Factor	Inspection Frequency
5 and above	Fracture Critical Members or Fatigue Sensitive Details	Two-year Interval
4 and below	Fracture Critical Members or Fatigue Sensitive Details	Determined by MBTA
4 and below (Overall Condition*)	Fracture Critical Bridge	Determined by MBTA

* Overall condition rating irrespective of condition rating of fracture critical members and fatigue sensitive details

2.5.5. Emergency Inspections

Emergency Inspections are performed to evaluate damage to a bridge caused by flood, fires, earthquake, derailment, collision or other unusual occurrences, and shall be performed in accordance with the requirements of AREMA Chapter 15, Section 7.4.5.

2.5.6. Underwater Inspections

Underwater inspections of substructures, including inspection for effects of scour should be performed to a degree of inspection intensity of the underwater structural elements so that the extent of damage and loss in cross-sectional area can be detected and recorded (i.e. detailed measurements, video, testing, etc.).

2.5.7. Summary

The MBTA Railroad Operations Directorate requires the following:

- **Periodic Inspections (1-year intervals)**
- **Special Inspections (5-year intervals)**
- **Underwater Inspections (5-year intervals)**
- **Emergency Inspections (as needed)**
- **Fracture Critical Inspections (minimum 2-year intervals)**

2.6. Inspection of MBTA Owned Highway Bridges

The frequency of inspection of MBTA owned highway bridges that are judged to be in good condition shall be two years, to be consistent with MHD and NBIS policy. Bridges in marginal condition and bridges that have fracture critical members shall be inspected at a frequency determined by the MBTA.

2.7. Procedure for Notification of Critical Inspection Findings

In the event that the inspector identifies a deficiency that in their judgment is critical to the safety of the public, warranting immediate action on the part of the MBTA, the Inspection Team Leader shall immediately contact the Program Manager and Contract Project Manager for the inspection contract if working as a consultant to the MBTA. Additionally, the Inspection Team Leader or Program Manager shall immediately [5]contact the Railroad Operations Directorate, Chief Engineer. All parties shall meet at the bridge in question including the Bridge Inspection Team Leader, Bridge Inspection Program Manager, and at a minimum at least one of the prime MBTA contact persons to discuss the appropriate course of action for continuing safe passage of train traffic.

2.8. Inspection Reports

2.8.1. General

All bridge inspections shall be documented in standardized reports, the formats of which will be provided by the Authority. Inspection reports shall include at a minimum, standardized inspection forms with numerical condition ratings and photographic documentation.

2.8.2. Railroad Bridge Inspection Forms

Standardized forms for Periodic Inspections, designed to include all types of bridges owned by the MBTA are included in Appendix A**.** The forms are intended to provide a uniform means of data collection for the Periodic Inspection, and to be a minimum checklist of bridge elements to be evaluated. The inspection forms included in Appendix A are consistent with MHD Bridge Inspection forms, and forms previously used by MBTA Design and Construction Directorate. Sample forms included in Appendix A are:

1. Railroad/Transit Bridge Inspection
2. Railroad/Transit Routine Arch Inspection
3. Routine Culvert Inspection
4. Pedestrian Bridge Routine Inspection
5. Highway Bridge; Routine Inspection

[5] For the purpose of this criteria/policy, immediately is defined as within four (4) hours from the time the inspector identifies a critical deficiency.

6. Divers Activity Report
7. Fracture Critical Inspection
8. Standard Remarks/Photo Page
9. Standard Fatigue Sensitive Details Notes Page

The standard bridge inspection forms are to be completed using numerical condition ratings ranging from 0 (Failed) to 9 (Excellent) based on the procedures described in the FHWA Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges for all bridge inspections.

2.8.3. Highway Inspection Forms

It is recommended that MBTA owned highway bridges follow the inspection standards, including inspection forms, used by MHD, which are outlined in the Massachusetts Highway Department Bridge Inspection Handbook.

2.8.4. Structure Inventory and Appraisal (SI&A) Forms

Structure Inventory and Appraisal forms for each bridge shall be edited with neat markings in red and forwarded to the MBTA for updating in the MBTA's Bridge Management System.

2.8.5. Inspection Reports

Periodic Inspections and Emergency Inspections need only be documented using the standard forms included in Appendix A, and shall include full photo documentation and detailed written descriptions, photographs, and appropriate sketches for all elements where deficiencies warrant a condition rating value less than 6 out of 9.

Full reports are to be submitted for all Special Inspections. Special Inspection Reports shall include the appropriate inspection form, a written narrative, locus plan, detailed sketches, and photographs as required using the format provided by the Authority.

2.8.5.1. Written Narrative

The written narrative shall at a minimum, include a description of the bridge, and a detailed description of all noted deficiencies.

2.8.5.2. Locus Plan

A single 8 ½ in. x 11 in. page of the inspection report shall contain a locus map with minimum dimensions of 6 in. x 8 in. with the bridge location clearly identified, and of adequate scale to easily locate the

bridge. The locus plan shall include a north arrow and bridge identification.

2.8.5.3. Detailed Sketches

All inspection reports shall include the following standard sketches as a minimum, followed by sketches of noted deficiencies:

1. Plan
2. Elevation
3. Cross Section
4. Pier Elevation

2.8.5.4. Standard Photos for Inspections

All inspection reports shall include the following standard photos as a minimum, followed by photo documentation of any/all deficiencies:

1. Bridge Elevation (N-S, E-W)
2. Bridge Elevation (N-S, E-W)
3. Bridge Approach (N-S, E-W)
4. Bridge Approach (N-S, E-W)
5. View Upstream
6. View Downstream
7. Typical Bridge Top Surface
8. Bridge Rail and Sidewalk if present (N-S, E-W)
9. Bridge Rail and Sidewalk if present (N-S, E-W)
10. Typical Bridge Underside
11. Bridge Abutment Elevation
12. Bridge Abutment Elevation
13. Bridge Wingwall Elevation
14. Bridge Wingwall Elevation
15. Bridge Wingwall Elevation
16. Bridge Wingwall Elevation
17. Bridge Pier(s) Elevation(s)

3. Load Rating of Bridges

3.1. General

Load ratings shall be completed in accordance with the requirements of the latest edition of the AREMA Manual for Railway Engineering and this chapter and shall bear the stamp and signature of a Professional Structural Engineer registered in the Commonwealth of Massachusetts. The rating Engineer shall use sound judgment when interpreting the requirements of rating guidelines. All ratings shall be performed using measured section properties. No load rating shall be performed using estimated losses.

Appendix B provides a sample rating summary chart, which shall have the controlling load ratings shaded to highlight governing elements, and shall bear the stamp and signature of a Professional Structural Engineer registered in the Commonwealth of Massachusetts.

3.2. Railroad Loadings used in Rating Calculations

The primary load cases that are of concern to MBTA Railroad Operations are the F40PH – Modified Engine loading and 263 kip rail car, which typically travel over Authority-owned bridges. MBTA Railroad Operations shall be notified of all bridge load rating capacities for these load conditions. The evaluation of other load cases may be required by the MBTA Design and Construction Directorate.

3.2.1. Railroad Load Cases

3.2.1.1. F40PH – Modified Loading

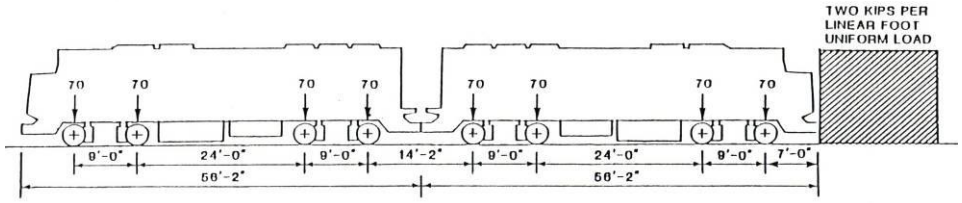
The F40PH-Modified Loading is the standard MBTA commuter rail loading applied daily to MBTA commuter rail bridges. Normal and Maximum Ratings shall be calculated for the F40PH-Modified loading shown below.

Rating values shall be expressed relative to four axle loads equal to **280 kips.** Bridges with normal rating values of less than 280 kips shall be considered deficient and will require specific recommendations to improve the normal rating to a minimum of 280 Kips.

TOTAL WEIGHT EACH LOCOMOTIVE 280,000 lbs.

AXLE LOAD IN KIPS

ONE TRACK OF TWO RAILS



F40PH-MODIFIED LOADING

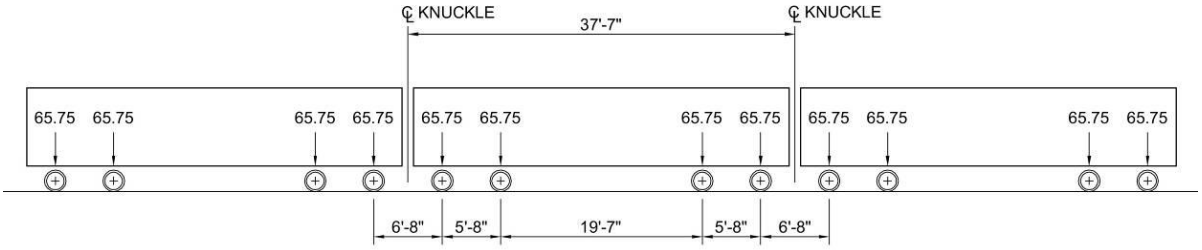
LOADS ARE REPRESENTATIVE OF THE F40-PH-2 ENGINE
AND DIMENSIONS OF THE F40PH ENGINE.

RATING IS EXPRESSED IN KIPS PROPORTIONAL TO THE 280 KIP LOCOMOTIVE SHOWN.

3.2.1.2. 263,000 Lbs. Freight Car Loading (263-Kip Rail Car)

This loading is the standard commercial freight loading applied to MBTA commuter rail bridges. Normal and Maximum Ratings shall be calculated for the 263-Kip Rail Car loading shown below, and shall be expressed relative to four axle loads equal to 263 kips. The proportionate rating values for the 286-kip Rail Car loading shall also be presented in the summary of load ratings for the structure.

Rating values shall be expressed relative to four axle loads equal to **263 kips.** Bridges with normal rating values of less than 263 kips shall be considered deficient and will require specific recommendations to improve the normal rating to a minimum of 263 Kips.



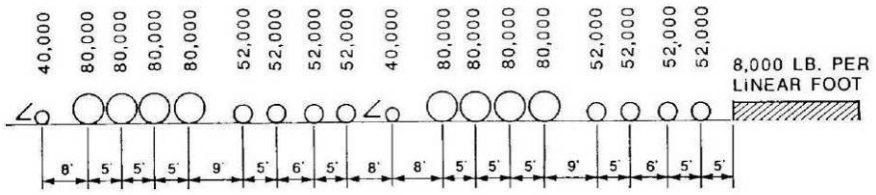
263 K LOADING

RATINGS ARE EXPRESSED IN KIPS PROPORTIONAL TO THE 263 KIP RAIL CAR SHOWN
(THE RATINGS FOR THE 286 KIP RAIL CAR AND THE 263 KIP RAIL CAR ARE PROPORTIONATE)

3.2.1.3. AREMA Cooper E-80 Loading

This loading is the standard AREMA load condition for which all railroad bridges nationwide are judged. Normal and Maximum Ratings shall be calculated for the Cooper E-80 loading shown below.

Rating values shall be expressed as the equivalent E value compared to a single axle load of **80 kips (E-80).**



AREMA COOPER E80 LOADING

LIVE LOAD IN LBS. PER AXLE

RATING IS EXPRESSED IN AXLE LOAD (KIPS) PROPORTIONAL TO COOPER E80

3.2.2. Normal Rating

Normal Rating is the load level that can be carried by the structure for its expected service life. Normal ratings shall be calculated and reported in accordance with the requirements of AREMA for each live load case with and without fatigue considerations. For bridges which have load ratings below normal limits listed in Sections 3.2.1, additional rating computations shall be performed using reduced operating speeds at 10-mile-per-hour increments between 60 mph and 10 mph. The rating engineer is not required to continue the reduced speed progression once the normal rating limit is achieved. The results of the reduced speed ratings shall be reported in the breakdown of bridge rating summary table. The procedures for incorporating speed reductions shall follow the latest edition of the AREMA Manual for Railway Engineering bridge rating guidelines.

If fatigue governs the bridge load rating, and the rating is below the normal limit, the engineer may be required by the Authority to calculate the remaining fatigue life of the structure.

3.2.3. Maximum Rating

Maximum Rating is the load level that the structure can support at infrequent intervals, with any applicable speed restrictions. Maximum Ratings shall be calculated and reported in accordance with the requirements of AREMA for each live load case. For bridges which have been evaluated for Normal load ratings at reduced speeds, additional Maximum rating computations shall be

performed for the corresponding speeds. The results of the reduced speed ratings shall be reported in the breakdown of bridge rating summary table.

3.3. Load Rating for MBTA Owned Highway Bridges

Ratings for MBTA owned highway bridges shall be performed following the load rating standards used by the MHD, which are outlined in Chapter 7 of the MHD Bridge Manual and the latest edition of the American Association of State Highway and Transportation Officials (AASHTO) Manual for Condition Evaluation of Bridges. Highway bridges shall include load ratings for MBTA bus loading as directed by the MBTA.

3.4. Rating Reports

Each Rating shall be presented in a report book which summarizes the rating values for the components of the bridge, with the overall rating value corresponding the controlling member element rating. Highway bridges shall be rated in accordance with the requirements of the MassHighway Bridge Manual, Chapter 7. Railroad bridges shall be rated for both Normal and Maximum Rating values, as well as reduced speed ratings if necessary (see sections 3.2.2 and 3.2.3 for criteria). Each Rating Report shall be prepared under the direction of, and bear the stamp and signature of a Professional Structural Engineer Registered in the Commonwealth of Massachusetts.

Each rating report shall contain the following:

1. Cover page indicating Structure information including Bridge Number, Structure Number, etc.
2. Rating Report Table of Contents
3. Breakdown of Bridge Rating Summary Tables
4. Location Plan
5. Description of bridge
6. Rating Analysis Assumptions and Criteria
7. Evaluation of Rating and Recommendations
8. List of available plans
9. Graphical representation of train loadings
10. Most Recent Inspection Report
11. Photographs of bridge
12. Rating Calculations (Indexed)
13. Previous Rating Report

Rating Reports shall be presented in a format as provided by the Authority.

3.4.1. Rating Recommendations

Recommendations included in the rating report may be general addressing the global condition and future maintenance or inspection of the bridge, or they may address specific deficiencies of the bridge. All recommendations shall be based on sound engineering judgment, and shall be clearly based upon the findings of the rating calculations. If normal or inventory ratings are less than stated statutory limits, then specific recommendations shall be made to increase the load carrying capacity of the bridge.

The engineer shall ensure that all recommendations are practical, prudent, and will not adversely affect the structure, long-term performance, maintenance, or revenue service without justification.

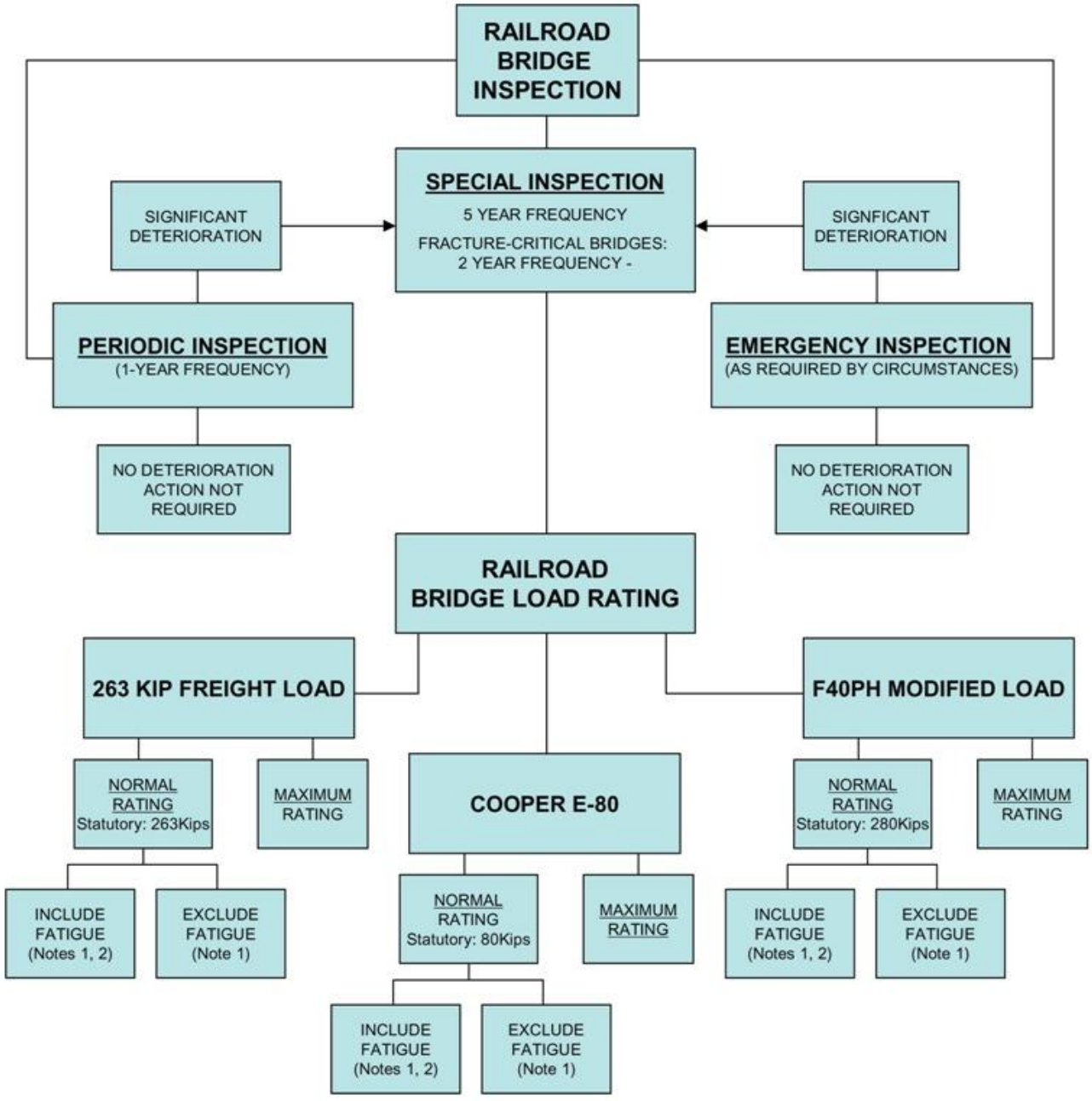
All deficiencies reported in the most recent inspection report shall be addressed within the rating report identifying the effect of the deficiency, if any on the bridge rating.

4. Summary

The MBTA Railroad Operations Directorate requires following:

- All Bridges shall have Periodic Inspections at 1-year intervals, and shall be documented using one of the standard forms included in Appendix A.
- All Bridges that are Fracture Critical shall be inspected at 2-year intervals unless condition or rating capacity of Fracture Critical Members warrants more frequent inspection interval. Inspection interval shall be determined by the Authority. All Fracture Critical inspections shall be documented using one of the standard forms included in Appendix A.
- Underwater Inspections of bridges over water shall occur at 5-year intervals, and shall be documented using the standard form included in Appendix A.
- Special Inspections of bridges shall occur at 5-year intervals, unless condition or rating capacity of bridge elements warrants more frequent inspection interval. Inspection interval shall be determined by the Authority. Special Inspections shall be documented in a full report including the standard forms included in Appendix A.

APPENDIX A



NOTES:
1. IF CALCULATED LOAD RATING IS BELOW REQURED MINIMUM NORMAL RATING, RECALCULATE USING REDUCED SPEED.
2. IF FATIGUE GOVERNS LOAD RATING AND RATING IS BELOW MINIMUM NORMAL RATING, CALCULATE REMAINING FATIGUE LIFE.

FIGURE A1 – Bridge Inspection And Rating Flow Chart

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

STRUCTURES INSPECTION FIELD REPORT

RAILROAD/TRANSIT BRIDGE INSPECTION

PAGE NO. 1 OF

2-DIST	B.I.N.	BRIDGE NO.

4-CITY/TOWN	8-STRUCTURE No./MDPW BRIDGE No.	MILE POST/T ID No.	41-STATUS	INSPECTION DATE

7-FACILITY CARRIED/LINE	MEMORIAL NAME/LOCAL NAME	27-YR BUILT	106-YR REBUILT	VERT. UNDERCLEARANCE

06-FEATURES INTERSECTED/BRIDGE OVER	26-FUNCTIONAL CLASS.	QUALITY CONTROL ENGINEER

43-STRUCTURE TYPE	22-OWNER	21-MAINTAINER	TEAM LEADER	NO. TRACKS

107-DECK TYPE	WEATHER	TEMP. (air)	TEAM MEMBERS	NO. SPANS

ITEM 58 DECK	–	DEF
1. Structural Condition		
2. Ballast		
3. Ties		
4. Deck Joints		
5. Walkways		
6. Drainage		
7. Fire Protection		
8. Handrails		
9. Utilities		
10. Approach Settlement		
11.		

APPROACHES		DEF
a. Appr. rail condition		
b. Appr. Railway Settlement		
c. Appr. Sidewalk Settlement		
d.		

OVERHEAD SIGNS (Attached to bridge)	(Y/N)	DEF
a. Condition of Welds		
b. Condition of Bolts		
c. Condition of Signs		

ITEM 59 SUPERSTRUCTURE	–	DEF
1. Girders, Beams or Trusses		
a. Top Flange or Chord		
b. Bottom Flange or Chord		
c. Web or Diagonals		
d. Truss Joints		
e. Bearing Stiffeners		
f. Cross Frames, Diaphragms		
g. Knee Braces		
h. Pins		
i. Rivets or Bolts		
j. Welds		
k. Conn Plt's, Gussets & Angles		
l. Top Lateral Bracing		
m. Bottom Lateral Bracing		
n. Sway Frames		
o. Portals		
p. Hangers		
q. Bearings		
r.		
2. Floor Beams		
a. Top Flanges		
b. Bottom Flanges		
c. Webs		
d. Stiffeners		
e. Rivets or Bolts		
f. Welds		
g. Connections		
h.		
3. Stringers		
a. Top Flanges		
b. Bottom Flanges		
c. Webs		
d. Stiffeners		
e. Rivets or Bolts		
f. Welds		
g. Connections		
h. Diaphragms		
i.		
4. Superstructure (General)		
a. Paint		
b. Action Under Trains		
c. Collision Damage		
d. Member Alignment		
e.		

ITEM 60 SUBSTRUCTURE		DEF
1. Abutments		
a. Stems		
b. Wingwalls		
c. Backwalls		
d. Pedestals		
e. Bridge Seat		
f. Pointing		
g. Footing		
h. Erosion		
i. Settlement		
j.		
2. Piers or Bents		
a. Piles		
b. Footings		
c. Stem or Columns		
d. Cap Beams		
e. Top of Stem or Cap		
f. Pedestals		
g. Diagonal Bracing		
h. Fender System		
i. Erosion or Scour		
j. Settlement		
k. Pointing		
l.		

UNDERMINING (Y/N) *If YES please explain*

COLLISION DAMAGE:
None ( ) Minor ( ) Moderate ( ) Severe ( )

I-60 (Dive Report): *I-60 (This Report):*

93b-U/W (DIVE) INSP DATE:

Any Fracture Critical Member : (Y/N)

Any Cracks in Tension Plates : (Y/N)

Year Painted :

COLLISION DAMAGE:
None ( ) Minor ( ) Moderate ( ) Severe ( )

LOAD DEFLECTION:
None ( ) Minor ( ) Moderate ( ) Severe ( )

LOAD VIBRATION:
None ( ) Minor ( ) Moderate ( ) Severe ( )

X=UNKNOWN N=NOT APPLICABLE H=HIDDEN/INACCESSBLE R=REMOVED

FIGURE A2 – Railroad/Transit Inspection Form

PAGE NO. 2 OF

CITY/TOWN	B.I.N.	BR. DEPT. NO.	8-STRUCTURE NO.	INSPECTION DATE

ITEM 61 *CHANNEL & CHANNEL PROTECTION*

		DEF
1. Channel Scour		
2. Embankment Erosion		
3. Drift		
4. Channel Alignment		
5. Vegetation		
6. Rip-Rap		
7. Silt		
8. Debris in Channel		
9.		

ITEM 62 *CULVERT & RETAINING WALLS*

		DEF			DEF
1. Barrel			5. Settlement		
2. Headwall			6. Footings		
3. Wingwalls			7. Adequacy of Cover		
4. Cutoff Wall			8.		

Rating Report (Y/N):

Request for Rating or Rerating (Y/N):

HIGH ( ) MEDIUM ( ) LOW ( )

Reason:_____

_____

_____

ACCESSIBILITY: (Y/N/P)

	Needed	Used
Lift Bucket		
Ladder		
Boat		
Wader		
Inspector 50		
Rigging		
Staging		
Traffic Control		
RR Flagger		
Police		
Other		

STREAM FLOW VELOCITY:
Tidal ( ) High ( ) Medium ( ) Low ( )

I-61 (Dive Report): ☐ ***I-61 (This Report):*** ☐

93b-U/W INSP DATE

CLEARANCE POSTING: N/E S/W

Not Applicable ( )

	N/E ft	N/E in	S/W ft	S/W in	meter
Actual Field Measurement					
Posted Clearance					

	At bridge N/E	At bridge S/W	Other Advance N/E	Other Advance S/W
Signs in Place (Y=Yes N=No)				
Legibility/ Visibility				

TOTAL HOURS:

PLANS: (Y/N) ☐

(V.C.R.): (Y/N) ☐

TAPE #: ____

List of Field Tests Performed:

GENERAL

	DEF
1. Clearance Signs	
2. Rail on Bridge	
3. Track Guard Rail	
4. Rail Fasteners	
5.	
6.	
7.	
8.	
9.	
10.	
11.	
12.	

CONDITION RATING GUIDE (for Items 58, 59, 60)

	CODE	CONDITION	DEFECTS
	N	NOT APPLICABLE	
G	9	EXCELLENT	Excellent condition.
G	8	VERY GOOD	No problem noted.
G	7	GOOD	Some minor problems.
F	6	SATISFACTORY	Structural elements show some minor deterioration.
F	5	FAIR	All primary structural elements are sound but may have minor section loss, cracking, spalling or scour.
P	4	POOR	Advanced section loss, deterioration, spalling or scour.
P	3	SERIOUS	Loss of section, deterioration, spalling or scour have seriously affected primary structural components. Local failures are possible. Fatigue cracks in steel or shear cracks in concrete may be present.
C	2	CRITICAL	Advanced deterioration of primary structural elements. Fatigue cracks in steel or shear cracks in concrete may be present or scour may have removed substructure support. Unless closely monitored it may be necessary to close the bridge until corrective action is taken.
C	1	"IMMINENT" FAILURE	Major deterioration or section loss present in critical structural components or obvious vertical or horizontal movement affecting structure stability. Bridge is closed to traffic but corrective action may put it back in light service.
	0	FAILED	Out of service - beyond corrective action.

DEFICIENCY REPORTING GUIDE

DEFICIENCY: A defect in a structure that requires corrective action.

CATEGORIES OF DEFICIENCIES:

M= Minor Deficiency - Deficiencies which are minor in nature, generally do not impact the structural integrity of the bridge and could easily be repaired. Examples include but are not limited to: Spalled concrete, Minor pot holes, Minor corrosion to steel, Minor scouring, Clogged drainage, etc.

S= Severe/Major Deficiency - Deficiencies which are more extensive in nature and need more planning and effort to repair. Examples include but are not limited to: Moderate to major deterioration in concrete, Exposed and corroding rebars, Considerable settlement, Considerable scouring or undermining, Moderate to extensive corrosion to structural steel with measurable loss of section, etc.

C-S= Critical-Structural Deficiency - A deficiency in a structural element of a bridge that poses an extreme unsafe condition due to the failure or imminent failure of the element which will affect the structural integrity of the bridge.

C-H= Critical-Hazard Deficiency - A deficiency in a component or element of a bridge that poses an extreme hazard or unsafe condition to the public, but does not impair the structural integrity of the bridge. Examples include but are not limited to: Loose concrete hanging down over traffic or pedestrians, A hole in a sidewalk that may cause injuries to pedestrians, Missing section of bridge railing, etc.

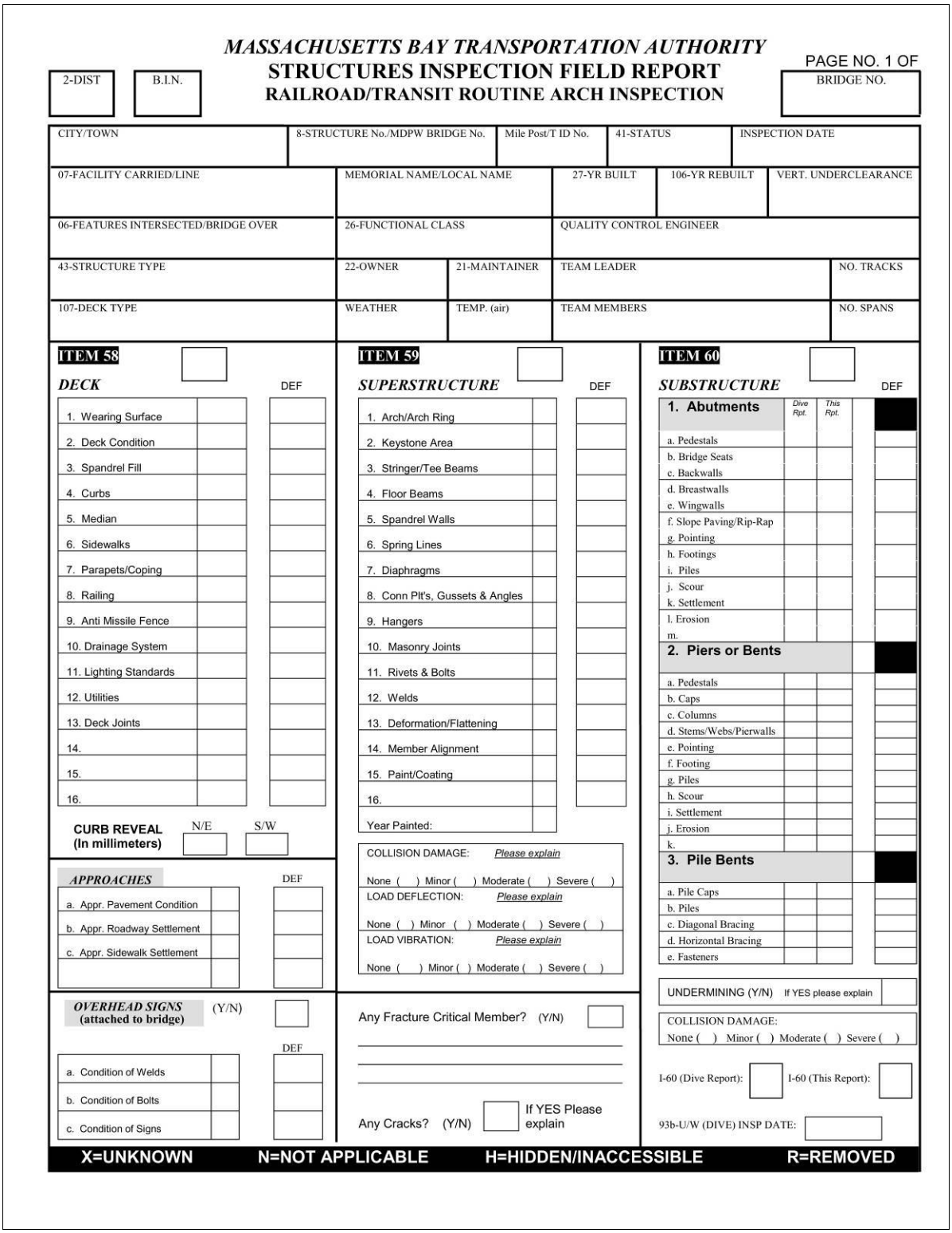
URGENCY OF REPAIR:

I= Immediate - [Inspector(s) immediately contact District Bridge Inspection Engineer (DBIE) to report the Deficiency and to receive further instruction from him/her].

A= As soon as possible - [Action/Repair should be initiated by District Maintenance Engineer or the Responsible Party (if not a State owned bridge) upon receipt of the Inspection Report].

P= Prioritize - [Shall be prioritized by District Maintenance Engineer or the Responsible Party (if not a State owned bridge) and repairs made when funds and/or manpower is available].

FIGURE A2 – Railroad/Transit Inspection Form



MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
STRUCTURES INSPECTION FIELD REPORT
RAILROAD/TRANSIT ROUTINE ARCH INSPECTION

PAGE NO. 1 OF

2-DIST	B.I.N.	BRIDGE NO.

CITY/TOWN	8-STRUCTURE No./MDPW BRIDGE No.	Mile Post/T ID No.	41-STATUS	INSPECTION DATE

07-FACILITY CARRIED/LINE	MEMORIAL NAME/LOCAL NAME	27-YR BUILT	106-YR REBUILT	VERT. UNDERCLEARANCE

06-FEATURES INTERSECTED/BRIDGE OVER	26-FUNCTIONAL CLASS	QUALITY CONTROL ENGINEER

43-STRUCTURE TYPE	22-OWNER	21-MAINTAINER	TEAM LEADER	NO. TRACKS

107-DECK TYPE	WEATHER	TEMP. (air)	TEAM MEMBERS	NO. SPANS

ITEM 58 ☐

DECK

		DEF
1. Wearing Surface		
2. Deck Condition		
3. Spandrel Fill		
4. Curbs		
5. Median		
6. Sidewalks		
7. Parapets/Coping		
8. Railing		
9. Anti Missile Fence		
10. Drainage System		
11. Lighting Standards		
12. Utilities		
13. Deck Joints		
14.		
15.		
16.		

CURB REVEAL (In millimeters) N/E ☐ S/W ☐

APPROACHES

		DEF
a. Appr. Pavement Condition		
b. Appr. Roadway Settlement		
c. Appr. Sidewalk Settlement		

OVERHEAD SIGNS **(attached to bridge)** (Y/N) ☐

		DEF
a. Condition of Welds		
b. Condition of Bolts		
c. Condition of Signs		

ITEM 59 ☐

SUPERSTRUCTURE

		DEF
1. Arch/Arch Ring		
2. Keystone Area		
3. Stringer/Tee Beams		
4. Floor Beams		
5. Spandrel Walls		
6. Spring Lines		
7. Diaphragms		
8. Conn Plt's, Gussets & Angles		
9. Hangers		
10. Masonry Joints		
11. Rivets & Bolts		
12. Welds		
13. Deformation/Flattening		
14. Member Alignment		
15. Paint/Coating		
16.		
Year Painted:		

COLLISION DAMAGE: *Please explain*
None ( ) Minor ( ) Moderate ( ) Severe ( )

LOAD DEFLECTION: *Please explain*
None ( ) Minor ( ) Moderate ( ) Severe ( )

LOAD VIBRATION: *Please explain*
None ( ) Minor ( ) Moderate ( ) Severe ( )

Any Fracture Critical Member? (Y/N) ☐

Any Cracks? (Y/N) ☐ If YES Please explain

ITEM 60 ☐

SUBSTRUCTURE

	Dive Rpt.	This Rpt.	DEF
1. Abutments			
a. Pedestals			
b. Bridge Seats			
c. Backwalls			
d. Breastwalls			
e. Wingwalls			
f. Slope Paving/Rip-Rap			
g. Pointing			
h. Footings			
i. Piles			
j. Scour			
k. Settlement			
l. Erosion			
m.			
2. Piers or Bents			
a. Pedestals			
b. Caps			
c. Columns			
d. Stems/Webs/Pierwalls			
e. Pointing			
f. Footing			
g. Piles			
h. Scour			
i. Settlement			
j. Erosion			
k.			
3. Pile Bents			
a. Pile Caps			
b. Piles			
c. Diagonal Bracing			
d. Horizontal Bracing			
e. Fasteners			

UNDERMINING (Y/N) If YES please explain ☐

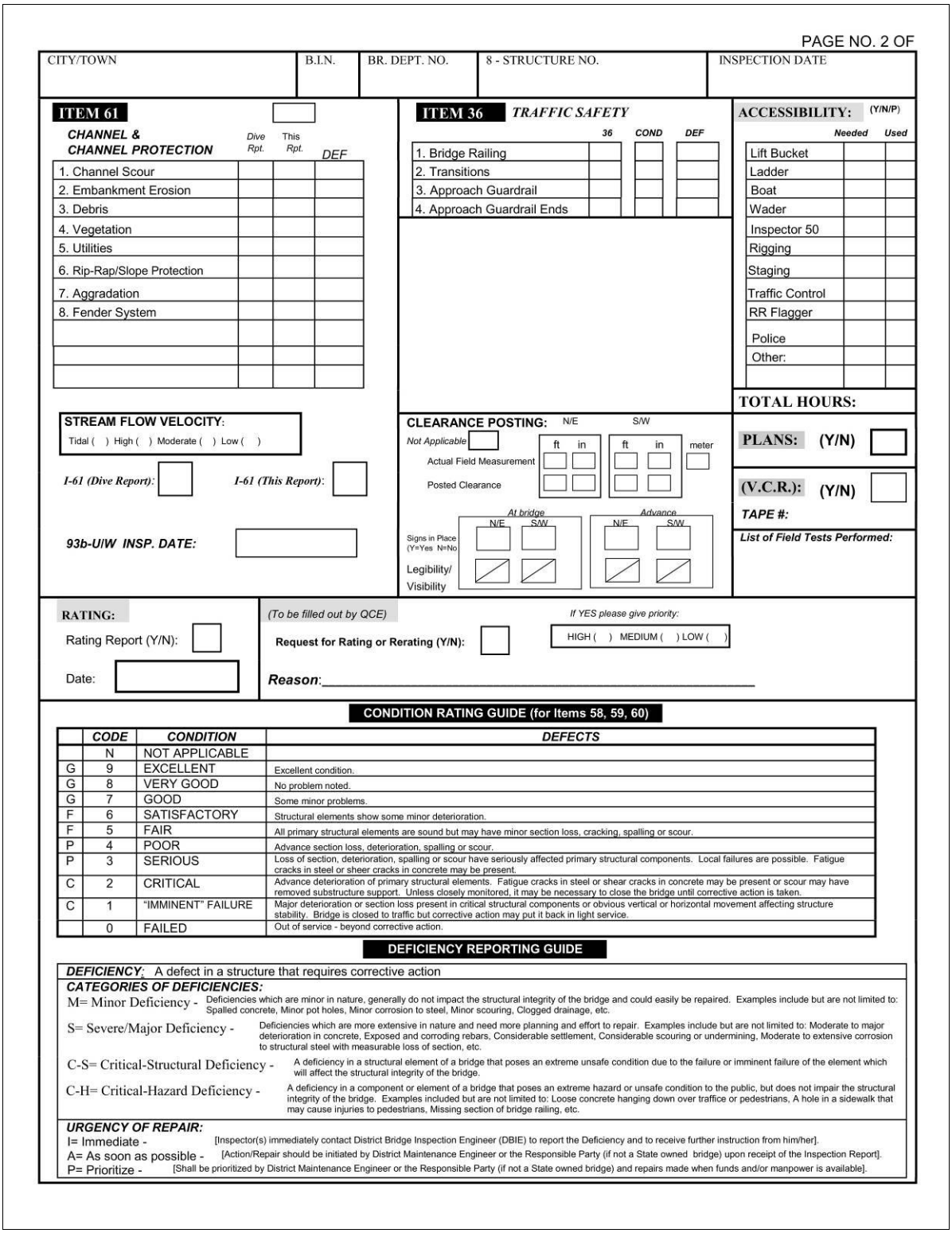
COLLISION DAMAGE:
None ( ) Minor ( ) Moderate ( ) Severe ( )

I-60 (Dive Report): ☐ I-60 (This Report): ☐

93b-U/W (DIVE) INSP DATE: ☐

X=UNKNOWN **N=NOT APPLICABLE** **H=HIDDEN/INACCESSIBLE** **R=REMOVED**

FIGURE A3 – Railroad/Transit Routine Arch Inspection Form



PAGE NO. 2 OF

CITY/TOWN	B.I.N.	BR. DEPT. NO.	8 - STRUCTURE NO.	INSPECTION DATE

ITEM 61 ☐

CHANNEL & CHANNEL PROTECTION

	Dive Rpt.	This Rpt.	DEF
1. Channel Scour			
2. Embankment Erosion			
3. Debris			
4. Vegetation			
5. Utilities			
6. Rip-Rap/Slope Protection			
7. Aggradation			
8. Fender System			

STREAM FLOW VELOCITY:
Tidal ( ) High ( ) Moderate ( ) Low ( )

I-61 (Dive Report): ☐ *I-61 (This Report):* ☐

93b-U/W INSP. DATE:

ITEM 36 *TRAFFIC SAFETY*

	36	COND	DEF
1. Bridge Railing			
2. Transitions			
3. Approach Guardrail			
4. Approach Guardrail Ends			

CLEARANCE POSTING: N/E S/W

Not Applicable ☐

	N/E ft	N/E in	S/W ft	S/W in	meter
Actual Field Measurement					
Posted Clearance					

	At bridge N/E	At bridge S/W	Advance N/E	Advance S/W
Signs in Place (Y=Yes N=No)				
Legibility/ Visibility				

ACCESSIBILITY: (Y/N/P)

	Needed	Used
Lift Bucket		
Ladder		
Boat		
Wader		
Inspector 50		
Rigging		
Staging		
Traffic Control		
RR Flagger		
Police		
Other:		

TOTAL HOURS:

PLANS: (Y/N) ☐

(V.C.R.): (Y/N) ☐

TAPE #:

List of Field Tests Performed:

RATING:
Rating Report (Y/N): ☐
Date: ☐

(To be filled out by QCE)
Request for Rating or Rerating (Y/N): ☐
If YES please give priority:
HIGH ( ) MEDIUM ( ) LOW ( )
Reason: _____

CONDITION RATING GUIDE (for Items 58, 59, 60)

	CODE	CONDITION	DEFECTS
	N	NOT APPLICABLE	
G	9	EXCELLENT	Excellent condition.
G	8	VERY GOOD	No problem noted.
G	7	GOOD	Some minor problems.
F	6	SATISFACTORY	Structural elements show some minor deterioration.
F	5	FAIR	All primary structural elements are sound but may have minor section loss, cracking, spalling or scour.
P	4	POOR	Advance section loss, deterioration, spalling or scour.
P	3	SERIOUS	Loss of section, deterioration, spalling or scour have seriously affected primary structural components. Local failures are possible. Fatigue cracks in steel or sheer cracks in concrete may be present.
C	2	CRITICAL	Advance deterioration of primary structural elements. Fatigue cracks in steel or shear cracks in concrete may be present or scour may have removed substructure support. Unless closely monitored, it may be necessary to close the bridge until corrective action is taken.
C	1	"IMMINENT" FAILURE	Major deterioration or section loss present in critical structural components or obvious vertical or horizontal movement affecting structure stability. Bridge is closed to traffic but corrective action may put it back in light service.
	0	FAILED	Out of service - beyond corrective action.

DEFICIENCY REPORTING GUIDE

DEFICIENCY: A defect in a structure that requires corrective action

CATEGORIES OF DEFICIENCIES:

M= Minor Deficiency - Deficiencies which are minor in nature, generally do not impact the structural integrity of the bridge and could easily be repaired. Examples include but are not limited to: Spalled concrete, Minor pot holes, Minor corrosion to steel, Minor scouring, Clogged drainage, etc.

S= Severe/Major Deficiency - Deficiencies which are more extensive in nature and need more planning and effort to repair. Examples include but are not limited to: Moderate to major deterioration in concrete, Exposed and corroding rebars, Considerable settlement, Considerable scouring or undermining, Moderate to extensive corrosion to structural steel with measurable loss of section, etc.

C-S= Critical-Structural Deficiency - A deficiency in a structural element of a bridge that poses an extreme unsafe condition due to the failure or imminent failure of the element which will affect the structural integrity of the bridge.

C-H= Critical-Hazard Deficiency - A deficiency in a component or element of a bridge that poses an extreme hazard or unsafe condition to the public, but does not impair the structural integrity of the bridge. Examples included but are not limited to: Loose concrete hanging down over traffice or pedestrians, A hole in a sidewalk that may cause injuries to pedestrians, Missing section of bridge railing, etc.

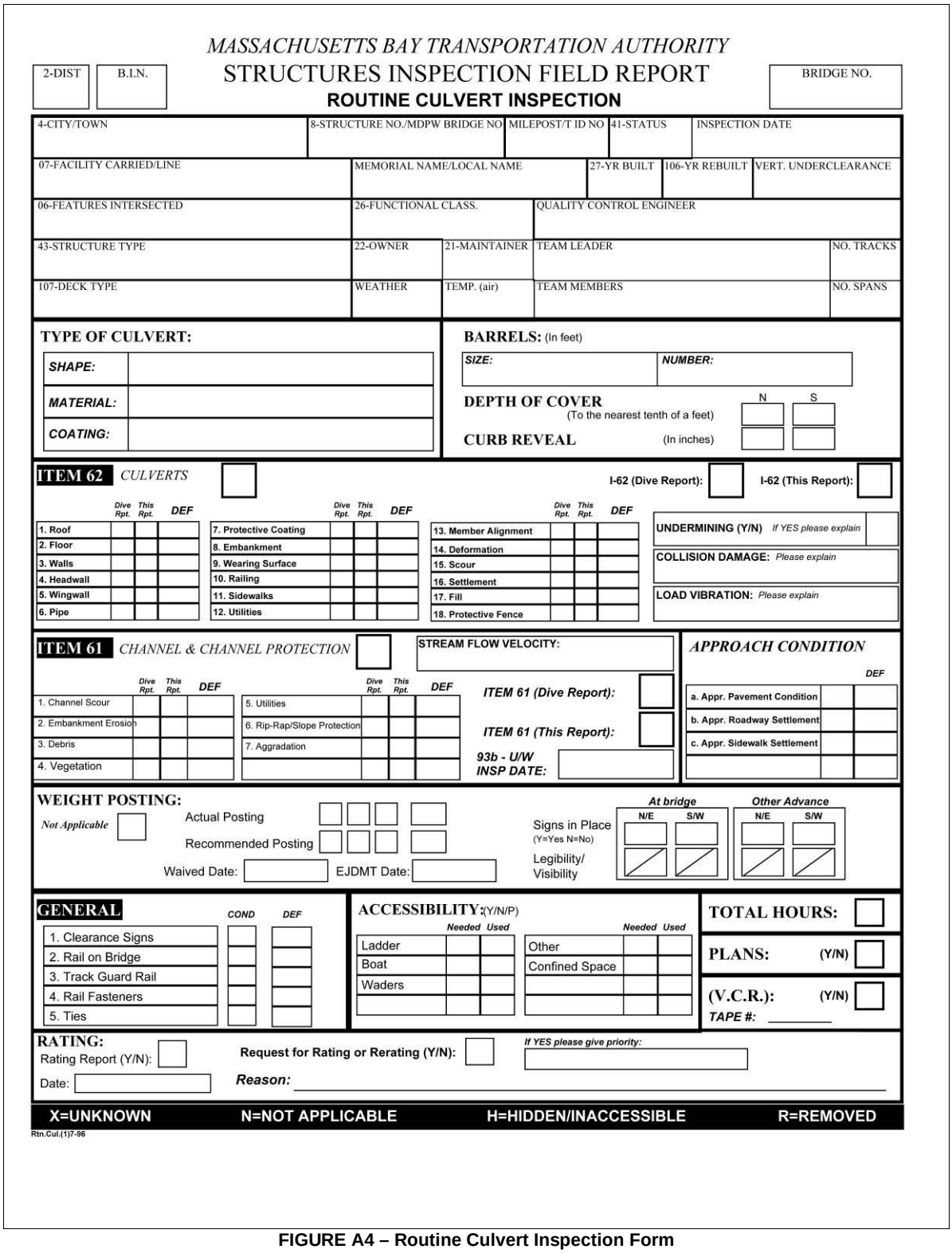
URGENCY OF REPAIR:

I= Immediate - [Inspector(s) immediately contact District Bridge Inspection Engineer (DBIE) to report the Deficiency and to receive further instruction from him/her].

A= As soon as possible - [Action/Repair should be initiated by District Maintenance Engineer or the Responsible Party (if not a State owned bridge) upon receipt of the Inspection Report].

P= Prioritize - [Shall be prioritized by District Maintenance Engineer or the Responsible Party (if not a State owned bridge) and repairs made when funds and/or manpower is available].

FIGURE A3 – Railroad/Transit Routine Arch Inspection Form



MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

STRUCTURES INSPECTION FIELD REPORT

ROUTINE CULVERT INSPECTION

2-DIST | B.I.N. | BRIDGE NO.

4-CITY/TOWN	8-STRUCTURE NO./MDPW BRIDGE NO	MILEPOST/T ID NO	41-STATUS	INSPECTION DATE

07-FACILITY CARRIED/LINE	MEMORIAL NAME/LOCAL NAME	27-YR BUILT	106-YR REBUILT	VERT. UNDERCLEARANCE

06-FEATURES INTERSECTED	26-FUNCTIONAL CLASS.	QUALITY CONTROL ENGINEER

43-STRUCTURE TYPE	22-OWNER	21-MAINTAINER	TEAM LEADER	NO. TRACKS

107-DECK TYPE	WEATHER	TEMP. (air)	TEAM MEMBERS	NO. SPANS

TYPE OF CULVERT:

SHAPE:	
MATERIAL:	
COATING:	

BARRELS: (In feet)

SIZE:	*NUMBER:*

DEPTH OF COVER (To the nearest tenth of a feet) — N | S

CURB REVEAL (In inches) — N | S

ITEM 62 *CULVERTS* — I-62 (Dive Report): | I-62 (This Report):

	Dive Rpt.	This Rpt.	DEF
1. Roof			
2. Floor			
3. Walls			
4. Headwall			
5. Wingwall			
6. Pipe			
7. Protective Coating			
8. Embankment			
9. Wearing Surface			
10. Railing			
11. Sidewalks			
12. Utilities			
13. Member Alignment			
14. Deformation			
15. Scour			
16. Settlement			
17. Fill			
18. Protective Fence			

UNDERMINING (Y/N) *If YES please explain*

COLLISION DAMAGE: *Please explain*

LOAD VIBRATION: *Please explain*

ITEM 61 *CHANNEL & CHANNEL PROTECTION*

STREAM FLOW VELOCITY:

	Dive Rpt.	This Rpt.	DEF
1. Channel Scour			
2. Embankment Erosion			
3. Debris			
4. Vegetation			
5. Utilities			
6. Rip-Rap/Slope Protection			
7. Aggradation			

ITEM 61 (Dive Report):

ITEM 61 (This Report):

93b - U/W INSP DATE:

APPROACH CONDITION

	DEF
a. Appr. Pavement Condition	
b. Appr. Roadway Settlement	
c. Appr. Sidewalk Settlement	

WEIGHT POSTING:

Not Applicable

Actual Posting

Recommended Posting

Waived Date: | EJDMT Date:

Signs in Place (Y=Yes N=No) — *At bridge* N/E S/W | *Other Advance* N/E S/W

Legibility/ Visibility

GENERAL

	COND	DEF
1. Clearance Signs		
2. Rail on Bridge		
3. Track Guard Rail		
4. Rail Fasteners		
5. Ties		

ACCESSIBILITY:(Y/N/P)

	Needed	Used
Ladder		
Boat		
Waders		
Other		
Confined Space		

TOTAL HOURS:

PLANS: (Y/N)

(V.C.R.): (Y/N)

TAPE #: _____

RATING:

Rating Report (Y/N):

Date:

Request for Rating or Rerating (Y/N):

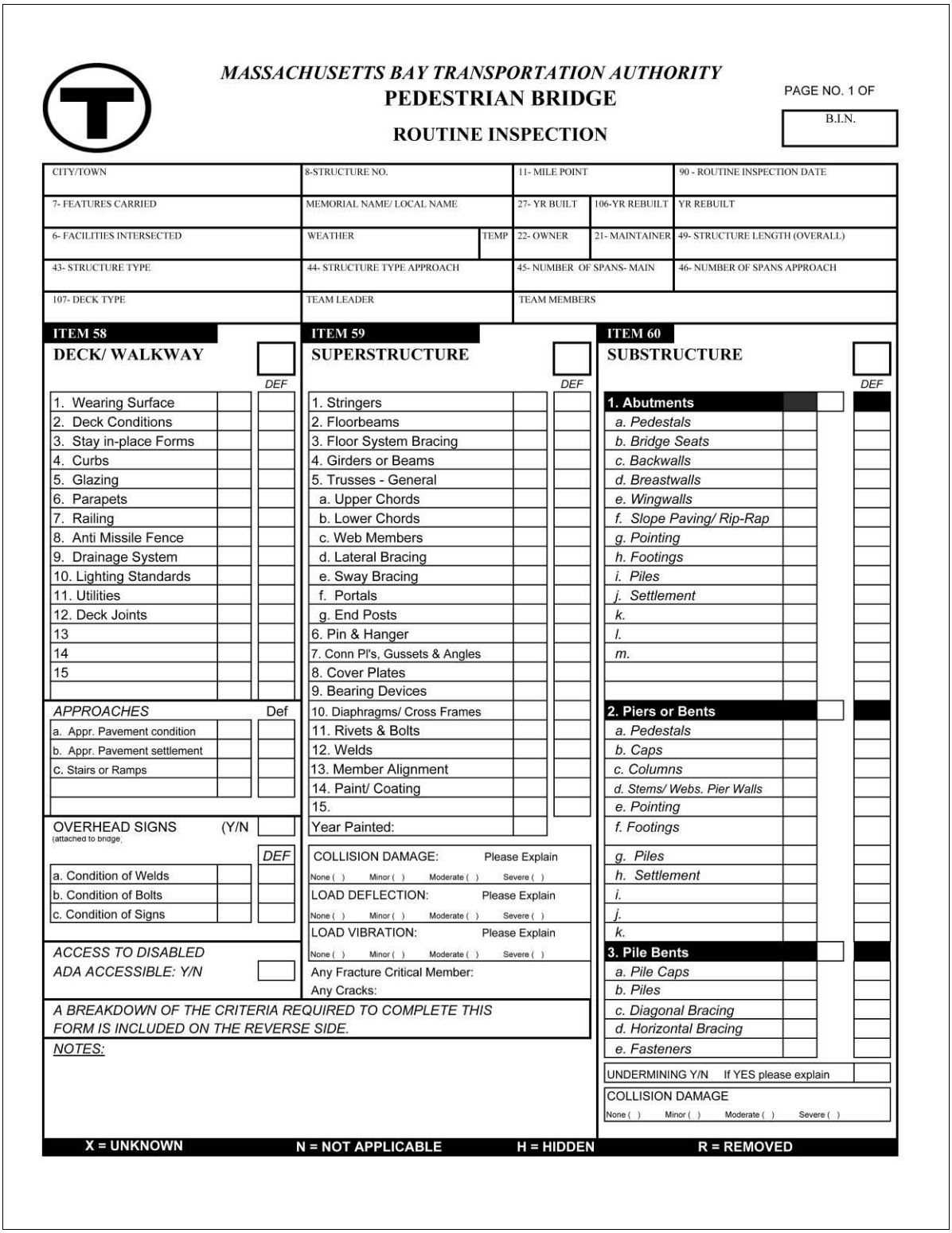
If YES please give priority:

Reason: _____

X=UNKNOWN **N=NOT APPLICABLE** **H=HIDDEN/INACCESSIBLE** **R=REMOVED**

Rtn.Cul.(1)7-96

FIGURE A4 – Routine Culvert Inspection Form



MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

PEDESTRIAN BRIDGE

ROUTINE INSPECTION

PAGE NO. 1 OF

B.I.N.

CITY/TOWN	8-STRUCTURE NO.	11- MILE POINT	90 - ROUTINE INSPECTION DATE
7- FEATURES CARRIED	MEMORIAL NAME/ LOCAL NAME	27- YR BUILT / 106-YR REBUILT	YR REBUILT
6- FACILITIES INTERSECTED	WEATHER / TEMP	22- OWNER / 21- MAINTAINER	49- STRUCTURE LENGTH (OVERALL)
43- STRUCTURE TYPE	44- STRUCTURE TYPE APPROACH	45- NUMBER OF SPANS- MAIN	46- NUMBER OF SPANS APPROACH
107- DECK TYPE	TEAM LEADER	TEAM MEMBERS	

ITEM 58 DECK/ WALKWAY

		DEF
1. Wearing Surface		
2. Deck Conditions		
3. Stay in-place Forms		
4. Curbs		
5. Glazing		
6. Parapets		
7. Railing		
8. Anti Missile Fence		
9. Drainage System		
10. Lighting Standards		
11. Utilities		
12. Deck Joints		
13		
14		
15		

APPROACHES		Def
a. Appr. Pavement condition		
b. Appr. Pavement settlement		
c. Stairs or Ramps		

OVERHEAD SIGNS (attached to bridge) (Y/N

		DEF
a. Condition of Welds		
b. Condition of Bolts		
c. Condition of Signs		

ACCESS TO DISABLED
ADA ACCESSIBLE: Y/N

ITEM 59 SUPERSTRUCTURE

		DEF
1. Stringers		
2. Floorbeams		
3. Floor System Bracing		
4. Girders or Beams		
5. Trusses - General		
a. Upper Chords		
b. Lower Chords		
c. Web Members		
d. Lateral Bracing		
e. Sway Bracing		
f. Portals		
g. End Posts		
6. Pin & Hanger		
7. Conn Pl's, Gussets & Angles		
8. Cover Plates		
9. Bearing Devices		
10. Diaphragms/ Cross Frames		
11. Rivets & Bolts		
12. Welds		
13. Member Alignment		
14. Paint/ Coating		
15.		
Year Painted:		

COLLISION DAMAGE: Please Explain
None ( ) Minor ( ) Moderate ( ) Severe ( )

LOAD DEFLECTION: Please Explain
None ( ) Minor ( ) Moderate ( ) Severe ( )

LOAD VIBRATION: Please Explain
None ( ) Minor ( ) Moderate ( ) Severe ( )

Any Fracture Critical Member:
Any Cracks:

A BREAKDOWN OF THE CRITERIA REQUIRED TO COMPLETE THIS FORM IS INCLUDED ON THE REVERSE SIDE.

NOTES:

ITEM 60 SUBSTRUCTURE

	DEF
1. Abutments	
a. Pedestals	
b. Bridge Seats	
c. Backwalls	
d. Breastwalls	
e. Wingwalls	
f. Slope Paving/ Rip-Rap	
g. Pointing	
h. Footings	
i. Piles	
j. Settlement	
k.	
l.	
m.	
2. Piers or Bents	
a. Pedestals	
b. Caps	
c. Columns	
d. Stems/ Webs. Pier Walls	
e. Pointing	
f. Footings	
g. Piles	
h. Settlement	
i.	
j.	
k.	
3. Pile Bents	
a. Pile Caps	
b. Piles	
c. Diagonal Bracing	
d. Horizontal Bracing	
e. Fasteners	

UNDERMINING Y/N If YES please explain

COLLISION DAMAGE
None ( ) Minor ( ) Moderate ( ) Severe ( )

X = UNKNOWN **N = NOT APPLICABLE** **H = HIDDEN** **R = REMOVED**

FIGURE A5 – Pedestrian Bridge Routine Inspection Form

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
PEDESTRIAN BRIDGE
ROUTINE INSPECTION (continued)

PAGE NO. 2 OF

CITY/TOWN	BIN	BR. DEPT. NO.	8-STRUCTURE NO.	90 - INSPECTION DATE

ACCESSIBILITY (Y/N/P)

	Needed	Used		Needed	Used
Lift Bucket			Staging		
Ladder			Traffic Control		
Boat			RR Flagger		
Wader			Police		
Inspector 50			Other:		
Rigging					

CONDITION RATING GUIDE (for Items 58, 59, 60)

	CODE	CONDITION	DEFECTS
	N	NOT APPLICABLE	
G	9	EXCELLENT	Excellent condition
G	8	VERY GOOD	No Problems Noted.
G	7	GOOD	Some Minor Problems
F	6	SATISFACTORY	Structural elements show some minor deterioration.
F	5	FAIR	All primary structural elements are sound but may have minor section loss, cracking, spalling or scour.
P	4	POOR	Advance section loss, deterioration, spalling, or scour.
P	3	SERIOUS	Loss of Section, deterioration, spalling or scour have seriously affected primary structural components. Local failures are possible. Fatigue cracks in steel or sheet cracks in concrete may be present.
C	2	CRITICAL	Advance deterioration of primary structural elements. Fatigue cracks in steel or shear cracks in concrete may be present or scour may have removed structural support. Unless closely monitored it may be necessary to close the bridge until corrective action is taken.
C	1	"IMMINENT" FAILURE	Major deterioration or section loss present in critical structural components or obvious vertical or horizontal movement involving structural stability. Bridge is closed to traffic but corrective action may put it back in light service.
	0	FAILED	Out of Service. Beyond Corrective Repair.

DEFICIENCY REPORTING GUIDE

DEFICIENCY : A defect in structure that required corrective actior

CATEGORIES OF DEFICIENCIES.

M= Minor deficiency - Deficiencies which are minor in nature, generally do not impact the structural integrity of the bridge and could easily be repaired. Examples include but are not limited to : Spalled concrete, Minor pot holes, Minor corrosion to steel, Minor scouring, Clogged drains, etc.

S= Severe/Major Deficiency - Deficiencies which are more extensive in nature and need more planning and effort to repair. Examples include but are not limited to: Moderate to major deterioration in concrete, Exposed and corroding rebars, Considerable settlement, Considerable scouring or undermining, Moderate to excessive corrosion to structural steel with measurable loss of section. etc

C-S= Critical-Structural Deficiency A deficiency in a structural element of a bridge that poses an extreme unusual condition due to the failure or imminent failure of the element which will affect the structural integrity of the bridge.

C-H= Critical-Hazard Deficiency A deficiency in a component or element of a bridge that poses an extreme hazard or unsafe condition to the public, but does not impair the structural integrity of the bridge. Examples include but are not limited to : Loose concrete hanging down over traffic or pedestrians, A hole in the deck that may cause injuries to pedestrians, Missing section of bridge railing, etc

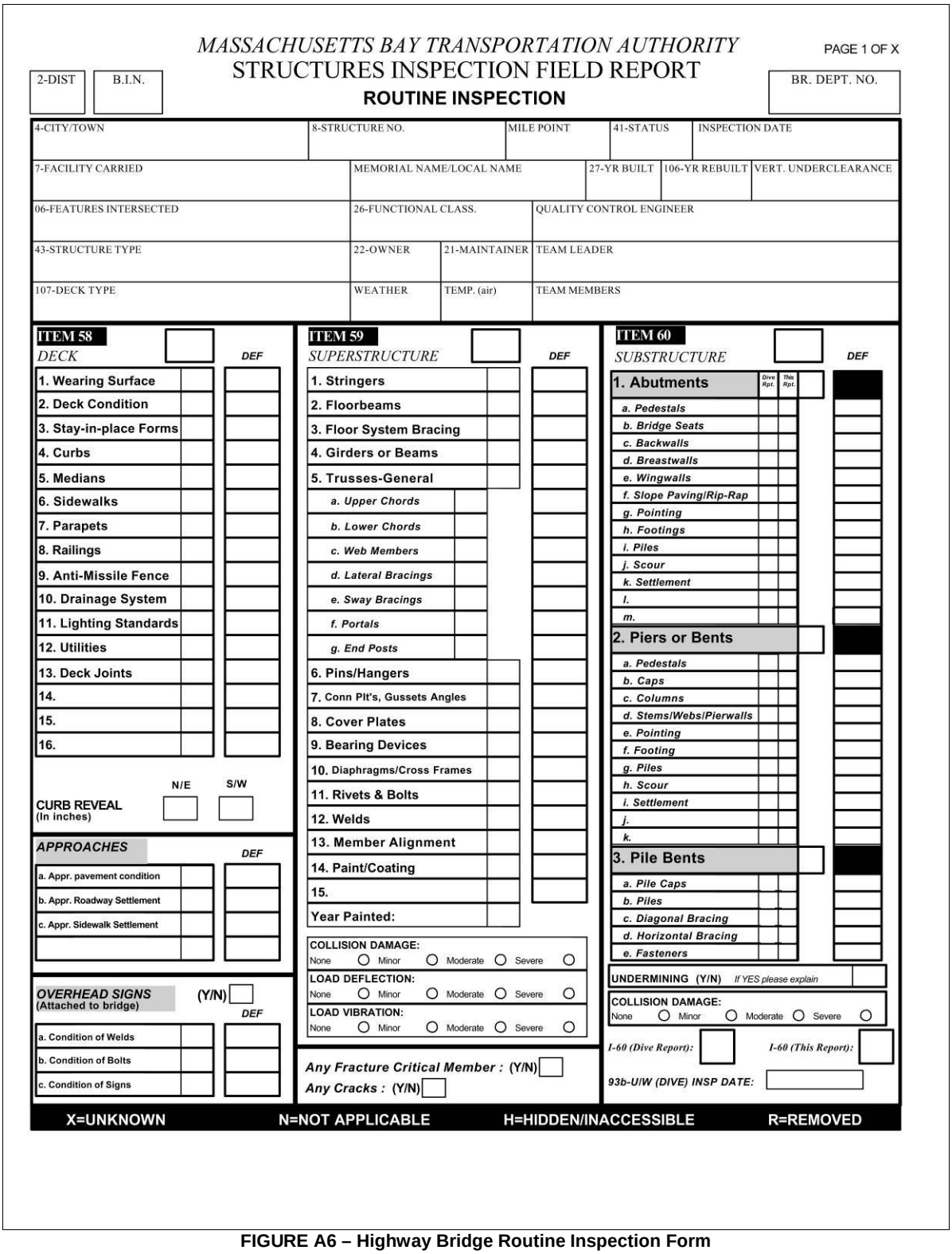
URGENCY OF REPAIR:

I = Immediate - Inspector(s) immediately contact MBTA Bridge Engineer to report the Deficiency and to receive further instruction from him/ her.

A = As soon as possible - (Action/ Repair should be initiated by MBTA Maintenance Engineer) upon receipt of the Inspection Report.

P = Prioritize - (Shall be prioritized by MBTA Maintenance Engineer and repairs made when funds and /or manpower is available)

FIGURE A5 – Pedestrian Bridge Routine Inspection Form



MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
STRUCTURES INSPECTION FIELD REPORT
ROUTINE INSPECTION

PAGE 1 OF X

2-DIST	B.I.N.	BR. DEPT. NO.

4-CITY/TOWN	8-STRUCTURE NO.	MILE POINT	41-STATUS	INSPECTION DATE

7-FACILITY CARRIED	MEMORIAL NAME/LOCAL NAME	27-YR BUILT	106-YR REBUILT	VERT. UNDERCLEARANCE

06-FEATURES INTERSECTED	26-FUNCTIONAL CLASS.	QUALITY CONTROL ENGINEER

43-STRUCTURE TYPE	22-OWNER	21-MAINTAINER	TEAM LEADER

107-DECK TYPE	WEATHER	TEMP. (air)	TEAM MEMBERS

ITEM 58 *DECK*

		DEF
1. Wearing Surface		
2. Deck Condition		
3. Stay-in-place Forms		
4. Curbs		
5. Medians		
6. Sidewalks		
7. Parapets		
8. Railings		
9. Anti-Missile Fence		
10. Drainage System		
11. Lighting Standards		
12. Utilities		
13. Deck Joints		
14.		
15.		
16.		

CURB REVEAL (In inches) N/E S/W

ITEM 59 *SUPERSTRUCTURE*

		DEF
1. Stringers		
2. Floorbeams		
3. Floor System Bracing		
4. Girders or Beams		
5. Trusses-General		
a. Upper Chords		
b. Lower Chords		
c. Web Members		
d. Lateral Bracings		
e. Sway Bracings		
f. Portals		
g. End Posts		
6. Pins/Hangers		
7. Conn Plt's, Gussets Angles		
8. Cover Plates		
9. Bearing Devices		
10. Diaphragms/Cross Frames		
11. Rivets & Bolts		
12. Welds		
13. Member Alignment		
14. Paint/Coating		
15.		
Year Painted:		

ITEM 60 *SUBSTRUCTURE*

	Dive Rpt.	Tha Rpt.		DEF
1. Abutments				
a. Pedestals				
b. Bridge Seats				
c. Backwalls				
d. Breastwalls				
e. Wingwalls				
f. Slope Paving/Rip-Rap				
g. Pointing				
h. Footings				
i. Piles				
j. Scour				
k. Settlement				
l.				
m.				
2. Piers or Bents				
a. Pedestals				
b. Caps				
c. Columns				
d. Stems/Webs/Pierwalls				
e. Pointing				
f. Footing				
g. Piles				
h. Scour				
i. Settlement				
j.				
k.				
3. Pile Bents				
a. Pile Caps				
b. Piles				
c. Diagonal Bracing				
d. Horizontal Bracing				
e. Fasteners				

APPROACHES

	DEF
a. Appr. pavement condition	
b. Appr. Roadway Settlement	
c. Appr. Sidewalk Settlement	

OVERHEAD SIGNS (Attached to bridge) (Y/N)

	DEF
a. Condition of Welds	
b. Condition of Bolts	
c. Condition of Signs	

COLLISION DAMAGE: None ○ Minor ○ Moderate ○ Severe ○

LOAD DEFLECTION: None ○ Minor ○ Moderate ○ Severe ○

LOAD VIBRATION: None ○ Minor ○ Moderate ○ Severe ○

Any Fracture Critical Member : (Y/N)

Any Cracks : (Y/N)

UNDERMINING (Y/N) *If YES please explain*

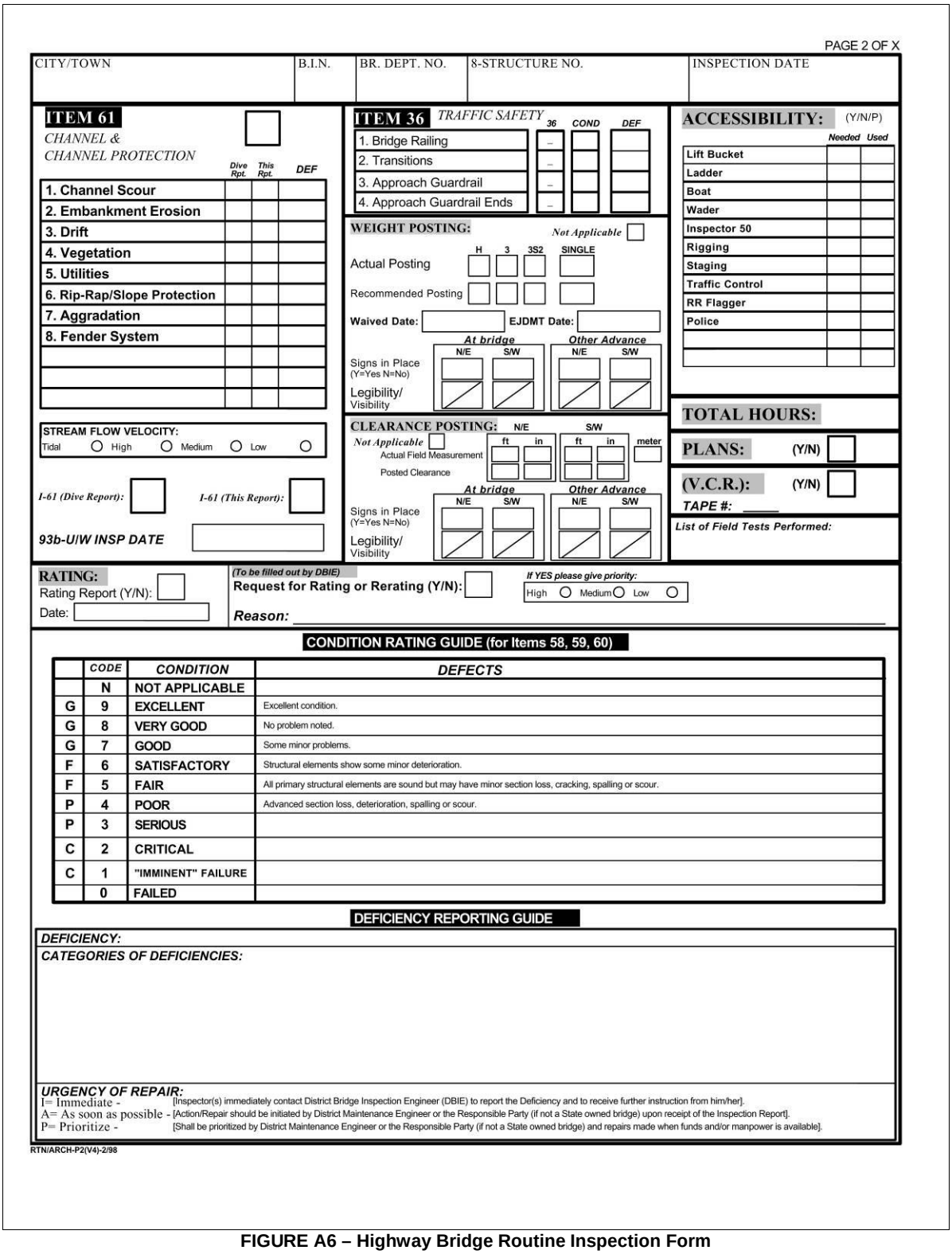
COLLISION DAMAGE: None ○ Minor ○ Moderate ○ Severe ○

I-60 (Dive Report): *I-60 (This Report):*

93b-U/W (DIVE) INSP DATE:

X=UNKNOWN **N=NOT APPLICABLE** **H=HIDDEN/INACCESSIBLE** **R=REMOVED**

FIGURE A6 – Highway Bridge Routine Inspection Form



PAGE 2 OF X

CITY/TOWN	B.I.N.	BR. DEPT. NO.	8-STRUCTURE NO.	INSPECTION DATE

ITEM 61 *CHANNEL & CHANNEL PROTECTION*

	Dive Rpt.	This Rpt.	DEF
1. Channel Scour			
2. Embankment Erosion			
3. Drift			
4. Vegetation			
5. Utilities			
6. Rip-Rap/Slope Protection			
7. Aggradation			
8. Fender System			

STREAM FLOW VELOCITY: Tidal ○ High ○ Medium ○ Low ○

I-61 (Dive Report): *I-61 (This Report):*

93b-U/W INSP DATE

ITEM 36 *TRAFFIC SAFETY*

	36	COND	DEF
1. Bridge Railing	_		
2. Transitions	_		
3. Approach Guardrail	_		
4. Approach Guardrail Ends	_		

WEIGHT POSTING: *Not Applicable* ☐

	H	3	3S2	SINGLE
Actual Posting				
Recommended Posting				

Waived Date: EJDMT Date:

	At bridge N/E	At bridge S/W	Other Advance N/E	Other Advance S/W
Signs in Place (Y=Yes N=No)				
Legibility/ Visibility				

CLEARANCE POSTING: *Not Applicable* ☐

	N/E ft	N/E in	S/W ft	S/W in	meter
Actual Field Measurement					
Posted Clearance					

	At bridge N/E	At bridge S/W	Other Advance N/E	Other Advance S/W
Signs in Place (Y=Yes N=No)				
Legibility/ Visibility				

ACCESSIBILITY: (Y/N/P)

	Needed	Used
Lift Bucket		
Ladder		
Boat		
Wader		
Inspector 50		
Rigging		
Staging		
Traffic Control		
RR Flagger		
Police		

TOTAL HOURS:

PLANS: (Y/N) ☐

(V.C.R.): (Y/N) ☐

TAPE #: ____

List of Field Tests Performed:

RATING: Rating Report (Y/N): ☐ Date:

(To be filled out by DBIE) **Request for Rating or Rerating (Y/N):** ☐ *If YES please give priority:* High ○ Medium ○ Low ○

Reason: _____

CONDITION RATING GUIDE (for Items 58, 59, 60)

	CODE	CONDITION	DEFECTS
	N	NOT APPLICABLE	
G	9	EXCELLENT	Excellent condition.
G	8	VERY GOOD	No problem noted.
G	7	GOOD	Some minor problems.
F	6	SATISFACTORY	Structural elements show some minor deterioration.
F	5	FAIR	All primary structural elements are sound but may have minor section loss, cracking, spalling or scour.
P	4	POOR	Advanced section loss, deterioration, spalling or scour.
P	3	SERIOUS	
C	2	CRITICAL	
C	1	"IMMINENT" FAILURE	
	0	FAILED	

DEFICIENCY REPORTING GUIDE

DEFICIENCY:

CATEGORIES OF DEFICIENCIES:

URGENCY OF REPAIR:

I= Immediate - [Inspector(s) immediately contact District Bridge Inspection Engineer (DBIE) to report the Deficiency and to receive further instruction from him/her].

A= As soon as possible - [Action/Repair should be initiated by District Maintenance Engineer or the Responsible Party (if not a State owned bridge) upon receipt of the Inspection Report].

P= Prioritize - [Shall be prioritized by District Maintenance Engineer or the Responsible Party (if not a State owned bridge) and repairs made when funds and/or manpower is available].

RTN/ARCH-P2(V4)-2/98

FIGURE A6 – Highway Bridge Routine Inspection Form

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

UNDERWATER OPERATIONS TEAM

DIVERS ACTIVITY REPORT

PAGE 1 OF 1

2-DIST	B.I.N.	BR. DEPT. NO.

4-CITY/TOWN	8-STRUCTURE NO.	LEVEL OF INSP.	93b-INSPECTION DATE
7-FACILITY CARRIED	ACCESS TO BRIDGE	UNDERWATER OPERATIONS ENGINEER	
06-FEATURES INTERSECTED	DEPTH / VISIBILITY	TEAM LEADER (DIVE MASTER)	*Report submitted by:*
BOTTOM CONDITION / CURRENT	TEAM MEMBERS		

ITEM 60 (Underwater) *SUBSTRUCTURE*

		DEF
1. Abutments		
a. Pedestals		
b. Bridge Seats		
c. Backwalls		
d. Breastwalls		
e. Wingwalls		
f. Slope Paving/Rip-Rap		
g. Pointing		
h. Footings		
i. Piles		
j. Scour		
k. Settlement		
l.		
2. Piers or Bents		
a. Pedestals		
b. Caps		
c. Columns		
d. Stems/Webs/Pierwalls		
e. Pointing		
f. Footing		
g. Piles		
h. Scour		
i. Settlement		
j.		
k.		
3. Pile Bents		
a. Pile Caps		
b. Piles		
c. Diagonal Bracing		
d. Horizontal Bracing		
e. Fasteners		

UNDERMINING (Y=Yes / N=No)

ITEM 61 *CHANNEL & CHANNEL PROTECTION*

		DEF
1. Channel Scour		
2. Embankment Erosion		
3. Drift		
4. Vegetation		
5. Utilities		
6. Rip-Rap/Slope Protection		
7. Aggradation		
8. Fender System		
a. Piles		
b. Diagonal Bracing		
c. Horizontal Bracing		
d. Wales		
e. Fasteners		
f. Ladders		

ITEM 59 *SUPERSTRUCTURE* (If any part done by divers.)

ITEM 62 *CULVERTS*

		DEF
1. Roof		
2. Floor		
3. Walls		
4. Headwall		
5. Wingwall		
6. Pipe		
7. Protective Coating		
8. Embankment		
9. Wearing Surface		
10. Railing		
11. Sidewalks		
12. Utilities		
13. Member Alignment		
14. Deformation		
15. Scour		
16. Settlement		

UNDERMINING (Y=Yes / N=No)

DEFICIENCY REPORTING GUIDE

DEFICIENCY: A defect in a structure that requires corrective action.

CATEGORIES OF DEFICIENCIES:

M= Minor Deficiency - Deficiencies which are minor in nature, generally do not impact the structural integrity of the bridge and could easily be repaired. Examples include but are not limited to: Spalled concrete, Minor scouring, etc.

S= Severe/Major Deficiency - Deficiencies which are more extensive in nature and need more planning and effort to repair. Examples include but are not limited to: Moderate to major deterioration in concrete, Exposed and corroding rebars, Deteriorated timber piles, Considerable settlement, Considerable scouring or undermining, etc.

C-S= Critical-Structural Deficiency - A deficiency in a structural element of a bridge that poses an extreme unsafe condition due to the failure or imminent failure of the element which will affect the structural integrity of the bridge.

C-H= Critical-Hazard Deficiency - A deficiency in a component or element of a bridge that poses an extreme hazard or unsafe condition to the public, but does not impair the structural integrity of the bridge. Examples include but are not limited to: Any part of piles or fender system which are projecting outward and may become a safety hazard for the navigational traffic, etc.

URGENCY OF REPAIR:

I= Immediate - [Inspector(s) immediately contact District Bridge Inspection Engineer (DBIE) to report the Deficiency and to receive further instruction from him/her].

A= As soon as possible - [Action/Repair should be initiated by District Maintenance Engineer or the Responsible Party (if not a State owned bridge) upon receipt of the Inspection Report].

P= Prioritize - [Shall be prioritized by District Maintenance Engineer or the Responsible Party (if not a State owned bridge) and repairs made when funds and/or manpower is available].

X=UNKNOWN **N=NOT APPLICABLE** **H=HIDDEN/INACCESSIBLE** **R=REMOVED**

DIVE-P1(V3)-4/98

FIGURE A7 – Divers Activity Report (Underwater Inspection) Form

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

PAGE 1 OF 3

STRUCTURES INSPECTION FIELD REPORT

FRACTURE CRITICAL INSPECTION

2-DIST	B.I.N.	BR. DEPT. NO.

4-CITY/TOWN	8-STRUCTURE NO.	11-MILE POST/T ID.	90-ROUTINE INSP. DATE	93a-F.C. INSP. DATE

7-FACILITY CARRIED	MEMORIAL NAME/LOCAL NAME	27-YR BUILT	106-YR REBUILT	YR REHAB'D (NON 106)

06-FEATURES INTERSECTED	26-FUNCTIONAL CLASS.	QUALITY CONTROL ENGINEER

43-STRUCTURE TYPE	22-OWNER	21-MAINTAINER	TEAM LEADER

107-DECK TYPE	WEATHER	TEMP. (air)	TEAM MEMBERS

WEIGHT POSTING: *Not Applicable* ☐

	E80	F40PH	SINGLE
Actual Posting	☐	☐	☐
Recommended Posting	☐	☐	☐

Waived Date: ____ **EJDMT Date:** ____

Signs in Place (Y=Yes N=No) / Legibility/ Visibility

	At bridge		*Other Advance*	
	N/E	S/W	N/E	S/W

RATING:
Rating Report (Y/N): ☐
Date: ____

(To be filled out by DBIE)
Request for Rating or Rerating (Y/N): ☐ *If YES please give priority:* ____

Reason:

PLANS: (Y/N) ☐

(V.C.R.): (Y/N) ☐
TAPE #: ____

FRACTURE CRITICAL MEMBER(S):

	MEMBER	CRACK (Y/N)	WELD'S CONDITION (0-9)	LOCATION OF CORROSION, SECTION LOSS (%), CRACKS, COLLISION DAMAGE, STRESS CONCENTRATION, ETC.	CONDITION PREVIOUS 9	CONDITION PRESENT 9	INV. RATING OF MEMBER FROM RATING ANALYSIS E80	INV. RATING OF MEMBER FROM RATING ANALYSIS F40PH	INV. RATING OF MEMBER FROM RATING ANALYSIS	*Deficiencies*
A										
B										
C										
D										
E										

List of field tests performed:

	I-59	I-60
(Overall Previous Condition)	☐	☐
(Overall Current Condition)	☐	☐

DEFICIENCY: A defect in a structure that requires corrective action.

M= Minor Deficiency-	Deficiencies which are minor in nature, generally do not impact the structural integrity of the bridge and could easily be repaired. Examples include but are not limited to: Spalled concrete, Minor pot holes, Minor corrosion to steel, Minor scouring, Clogged drainage, etc.
S= Severe/Major Deficiency-	Deficiencies which are more extensive in nature and need more planning and effort to repair. Examples include but are not limited to: Moderate to major deterioration in concrete. Exposed and corroding rebars, Considerable settlement, Considerable scouring or undermining, Moderate to extensive corrosion to structural steel with measurable loss of section, etc.
C-S= Critical-Structural Deficiency-	A deficiency in a structural element of a bridge that posses an extreme unsafe condition due to the failure or imminent failure of the element which will affect the structural integrity of the bridge.
C-H= Critical-Hazard Deficiency-	A deficiency in a component or element of a bridge that posses an extreme hazard or unsafe condition to the public, but does not impair the structural integrity of the bridge. Examples include but are not limited to: Loose concrete hanging down over traffic or pedestrians. A hole in a sidewalk that may cause injuries to pedestrians, Missing section of bridge railing, etc.

URGENCY OF REPAIR:

I= Immediate-	(Inspector (s) immediately contact District Bridge Inspector Engineer (DBIE) to report the Deficiency and to receive further instruction from him/her).
A= As soon as possible-	(Action/Repair should be initiated by District Maintenance Engineer or the Responsible Party (If not a State owned bridge) upon receipt of the Inspection Report).
P= Prioritize-	(Shall be prioritized by District Maintenance Engineer or the Responsible Party (if not a State owned bridge) and repairs made when funds and/or manpower is available).

X=UNKNOWN **N=NOT APPLICABLE** **H=HIDDEN/INACCESSIBLE** **R=REMOVED**

FIGURE A8 – Fracture Critical Inspection Form

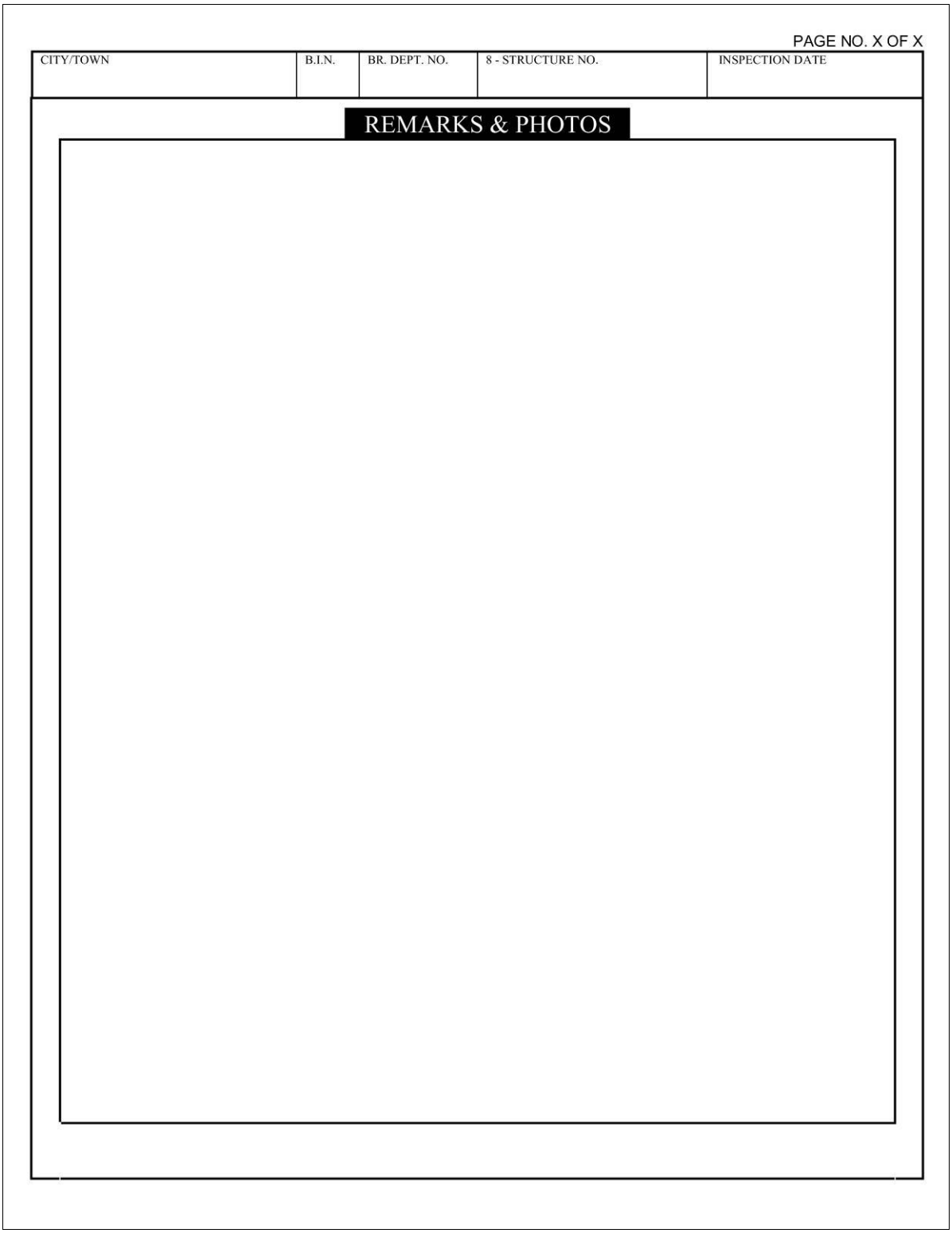


FIGURE A9 – Standard Remarks & Photos Page

PAGE NO. X OF x

CITY/TOWN	B.I.N.	BR. DEPT. NO.	8 - STRUCTURE NO.	INSPECTION DATE

FATIGUE SENSITIVE DETAILS

FATIGUE SENSITIVE DETAILS (FSD):

DESCRIPTION:

QUANTITY OF FSD TYPES:

Notes: 1. See attached sheets for description of Fatigue Sensitive Details
2. Refer to sketches and photos for locations of Fracture Critical Members and Fatigue Sensitive Details

FIGURE A10 – Standard Fatigue Sensitive Details Page

APPENDIX B

Bridge Rating Example Summary Table

SUMMARY OF BRIDGE RATING

TOWN/CITY: BRIDGE NO.:

MILE POINT:

CARRIES: OVER:

STRUCTURE NO.: BIN NO.:

RATINGS

	NORMAL	MAXIMUM
F40PH (280K) Modified		
263K Rail Car		
AREMA Cooper E-80		

Date:

Bridge Engineer Date

BREAKDOWN OF BRIDGE RATING

TOWN/CITY: BRIDGE NO.:

MILE POINT:

CARRIES: OVER:

STRUCTURE NO.: BIN NO.:

BRIDGE COMPONENT	NORMAL			MAXIMUM		
	F40PH (280K) Modified	263K Rail Car	AREMA Cooper E-80	F40PH (280K) Modified	263K Rail Car	AREMA Cooper E-80

BREAKDOWN OF BRIDGE RATING - FATIGUE

TOWN/CITY: BRIDGE NO.:

MILE POINT:

CARRIES: OVER:

STRUCTURE NO.: BIN NO.:

BRIDGE COMPONENT	NORMAL			MAXIMUM		
	F40PH (280K) Modified	263K Rail Car	AREMA Cooper E-80	F40PH (280K) Modified	263K Rail Car	AREMA Cooper E-80